

Running head: EGO DEPLETION AND RELAXATION

Active relaxation counteracts the effects of ego depletion on performance under evaluative  
pressure in a state of ego depletion

Chris Englert and Alex Bertrams

University of Bern

#### Author Note

Chris Englert, University of Bern, Institute of Educational Science, Department of Educational Psychology, Fabrikstrasse 8, 3012 Bern, Switzerland, Email: christoph.englert@edu.unibe.ch. Alex Bertrams, University of Bern, Institute of Educational Science, Department of Educational Psychology, Fabrikstrasse 8, 3012 Bern, Switzerland, Email: alexander.bertrams@edu.unibe.ch.

Correspondence concerning this article should be addressed to Chris Englert, University of Bern, Fabrikstrasse 8, CH-3012 Bern, Switzerland. E-mail: christoph.englert@edu.unibe.ch

**Abstract**

We tested the assumption that active relaxation following an ego-depletion task counteracts the negative effects of ego depletion on subsequent performance under evaluative pressure.  $N = 39$  experienced basketball players were randomly assigned to a relaxation condition or to a control condition, and then performed a series of free-throws at two points of measurement (T1: baseline vs T2: after working on a depleting task and either receiving active relaxation or a simple break). The results demonstrated that performance remained constant in the relaxation condition, whereas it significantly decreased in the control condition. The findings are in line with the notion that active relaxation leads to a quicker recovery from ego depletion.

*Keywords:* basketball, ego depletion, self-control, self-regulation, sport

### **Active relaxation counteracts the effects of ego depletion on performance under evaluative pressure**

1           In sports, for successful completion of far-aiming tasks (e.g., dart throwing), it is essential  
 2   to selectively control one's attention (e.g., Boutcher, 2002; Oudejans, van de Langenberg, &  
 3   Hutter, 2002). Irrelevant stimuli—for instance, internal worrisome thoughts or boisterous crowds  
 4   during a basketball match—need to be blocked out and attentional focus needs to be shifted to  
 5   the relevant stimuli (e.g., the bull's-eye in dart throwing) in order to perform at a high level (e.g.,  
 6   Vickers, 2011). However, according to attentional control theory (ACT; Eysenck, Derakshan,  
 7   Santos, & Calvo, 2007), evaluative pressure and accompanying sensations of anxiety can lead to  
 8   increased distractibility. Eysenck and colleagues argue that increased anxiety levels lead to a  
 9   domination of the bottom-up stimulus-driven attentional system, making it harder for athletes to  
 10   volitionally regulate their attention and perform optimally (Corbetta & Shulman, 2002). The  
 11   effect of evaluative pressure and anxiety on attention regulation and athletic performance is well  
 12   documented in the literature and has been replicated by several researchers (e.g., Wilson, Vine,  
 13   & Wood, 2009; Nibbeling, Oudejans, & Daanen, 2012). According to ACT, individuals are  
 14   generally capable of counteracting these detrimental anxiety effects on attention regulation by  
 15   investing additional effort. Recent research indicates that their success seems to depend on  
 16   available *self-control strength* (e.g., Englert & Bertrams, 2012, 2013, 2015). In the present work,  
 17   it was tested whether a brief intervention to keep self-control strength available helps to  
 18   counteract the detrimental effects of evaluative pressure on performance in a far-aiming task  
 19   (i.e., basketball free-throws).

20           Based on the assumptions of the strength model of self-control, all acts of self-control are  
 21   based on one resource with limited capacity (e.g., Baumeister, Bratslavsky, Muraven, & Tice,

1998). This resource can become temporarily depleted after having previously exerted self-control (i.e., *ego depletion*). As the resource is not immediately replenished, initial exertion of self-control can negatively affect subsequent self-control performance (e.g., Baumeister, Heatherton, & Tice, 1994). In this context, self-control is defined as the ability to volitionally regulate one's impulses or response tendencies, and to instead display another, more desirable behavior in order to achieve a specific goal (e.g., Baumeister et al., 1994). Acts requiring self-control include for instance emotion regulation, attention regulation, or impulse regulation (e.g., Friese, Hofmann, & Wänke, 2008; Schmeichel & Baumeister, 2010). In sports, athletes with depleted self-control strength have been found to be less persistent in physically demanding tasks (e.g., Englert & Wolff, 2015) and to display impaired tactical decision making (e.g., Furley, Bertrams, Englert, & Delphia, 2013). The results of a recent meta-analysis revealed a medium-to-large effect size of ego depletion on subsequent self-control performance (Hagger, Wood, Stiff, & Chatzisarantis, 2010).

        An integration of ACT (Eysenck et al., 2007) and the strength model of self-control (e.g., Baumeister et al., 1998) may explain under which circumstances individuals can counteract the detrimental effects of evaluative pressure on performance. In general, anxiety hinders selective attention regulation and automatically increases the degree of distractibility, which can impair performance (e.g., Eysenck et al., 2007). Numerous studies have delivered evidence of the negative effects of anxiety on performance (e.g., Wilson et al., 2009; Nibbeling et al., 2012). But according to ACT, the negative anxiety effects on attention regulation can be counteracted by initiating self-regulatory processes (Eysenck et al., 2007). Recent research has shown, that evaluative pressure and related anxiety were associated with impaired performance only when an initial self-control demand had recently depleted a person's self-control strength (i.e., during ego

depletion). No performance decrements emerged, however, for people whose self-control strength had not previously been depleted. This pattern was found in multiple experiments, for cognitive as well as far-aiming tasks (e.g., Bertrams, Englert, Dickhäuser, & Baumeister, 2013; Englert & Bertrams, 2012, 2013). Speaking in terms of ACT, these results indicate that individuals who had available self-control strength were able to volitionally work against the detrimental effects of anxiety on attention regulation. As attention regulation can be understood to be a process that depends on self-control strength (e.g., Schmeichel & Baumeister, 2010), self-control strength may serve as a protective shield against attention disruption.

Research based on the strength model also has revealed that self-control strength can be improved and revitalized. Baumeister and colleagues used a muscle analogy in their conceptualization of self-control strength: Self-control strength can become depleted after a primary self-control demand, just like a muscle can become exhausted after having previously performed a straining task (e.g., Baumeister et al., 1998). Sticking to the muscle analogy, self-control strength can also be boosted, like a muscle, for instance by regularly exerting self-control strength over a two-week period (Baumeister, Gailliot, DeWall, & Oaten, 2006). There are also possibilities to replenish self-control strength after previous acts of self-control. Mindfulness meditation, for instance, can serve as a strategy to revitalize one's depleted self-control strength (e.g., Friesse, Messner, & Schaffner, 2012). Moreover, relaxation and rest have been found to help replenish self-control strength (e.g., Baumeister et al., 1994).

Tyler and Burns (2008) had participants take a short break after a primary self-control task. In that study, one half of the participants were simply told that a second task would follow after three minutes, and they would have a break until the experiment resumed, whereas the other half of the sample applied additional active relaxation techniques. Participants from the

active relaxation condition showed superior performance in the second self-control task, and the authors concluded that active relaxation led to a quicker regeneration of self-control strength.

The goal of this study was to test the assumption that active relaxation following a primary task requiring self-control strength leads to a quicker revitalization of self-control strength and helps to maintain performance in sports tasks under high pressure conditions. We chose basketball free-throws as a far-aiming task, as performing basketball free-throws under pressure requires selective attention regulation in order to focus on the task at hand (e.g., Wilson et al., 2009). Attention regulation can be considered a self-control act (e.g., Schmeichel & Baumeister, 2010). Therefore, it was assumed that free-throw performance of participants who performed an active relaxation technique following an ego-depleting task would remain stable from a baseline measurement (i.e., 20 free-throws in a state of intact self-control strength) to a second time of measurement under pressure (i.e., 20 free-throws under pressure after working on the depletion task and after applying an active relaxation technique). By contrast, it was postulated that free-throw performance of participants who did not perform an active relaxation technique following an ego-depleting task would perform worse at a second time of measurement (i.e., 20 free-throws under pressure after working on the depletion task and after not applying an active relaxation technique) compared to their baseline free-throw performance.

## Method

### Participants

The final sample consisted of  $N = 39$  active basketball players. Three additional participants had to be excluded because they did not follow the experimental protocol and instead conventionally transcribed the transcription text, which is designed to deplete self-control strength ( $M_{\text{age}} = 24.41$ ,  $SD_{\text{age}} = 2.51$ ; 6 women, 33 men; three left-handed; free-throw percentage

of last season:  $M = 62.38$ ,  $SD = 12.68$ ; years of league play:  $M = 10.46$ ,  $SD = 5.10$ ). Participants were randomly assigned to a relaxation condition ( $n = 20$ ) or a control condition ( $n = 19$ ). The results of a G\*Power analysis revealed that our sample size was adequate in detecting at least a medium effect (Faul, Erdfelder, Lang, & Buchner, 2007; parameters:  $f = .25$ ,  $\alpha = .05$ ,  $1 - \beta = .80$ ,  $r_{\text{repeated measures}} = .50$ ,  $\epsilon = 1$ ). Before starting the experiment, participants delivered written informed consent. The study was carried out in accordance with the Helsinki Declaration of 1975.

## Procedure

The study was conducted by the same experimenter in single sessions in the indoor training facilities of the respective player (there was no effect of training facility on the performance measures in the current study). After reporting demographic information, participants performed a series of 20 free-throws from the regular basketball free-throw line (distance: 4.60 m) on a regulation-height basket (height: 3.04 m). The total number of successful shots out of 20 free-throws served as the performance measure. To match game situations, there was always a short interval after two free-throws (approximately three seconds). This measure served as a baseline measure of basketball free-throw performance, and as there had not been any manipulations up to this point, no differences between the two experimental conditions were expected.

In a next step, self-control strength was experimentally depleted in all participants by administering a transcription task which has been frequently used for this purpose (e.g., Bertrams, Englert, & Dickhäuser, 2010; Wolff, Baumgarten, & Brand, 2013). Participants transcribed a neutral text on a separate sheet of paper for six minutes and were instructed to omit the letters “e” and “n” while transcribing the text, which are the most frequent letters in the

German alphabet. Volitionally overriding well-learned writing habits requires a great deal of self-control; therefore, completing this task depletes self-control strength, as several studies have demonstrated (e.g., Englert & Bertrams, 2012; Bertrams et al., 2013; Wolff et al., 2013). The number of transcribed words and the number of mistakes were counted in order to make sure that both groups performed at a comparable level. Additionally, there were also several control measures applied, which will be described in more detail below.

Next, all participants put on stereo-headphones and were informed that there would be a two-minute break until the experiment continued. However, the instructions differed between the experimental conditions: In the active relaxation condition, participants were explicitly told to relax as much as possible and they additionally listened to a relaxing song (Erik Satie's *Gymnopedie No. 1*; Thibaudet, 2002) via stereo headphones. Participants from the control condition did not listen to any music and were simply told that the study would resume after two minutes. This procedure corresponded to Tyler and Burns (2008).

Following several control measures, participants performed a second series of 20 free-throws, however, this time under high pressure—they were informed that they would receive personal feedback, they would be videotaped, and that their video would be shown during a lecture in the upcoming semester (for this procedure, see also Behan & Wilson, 2008; Wilson et al., 2009; Englert & Bertrams, 2012). Before actually performing the free-throws, level of anxiety was measured. After finishing the free-throw task, we thanked participants for their participation, probed them for suspicion, and debriefed them. They were further explicitly told that their videos would not be shown during a lecture.

## Measures



As trait anxiety can negatively affect one's level of accuracy in far-aiming tasks (e.g., Wilson et al., 2009), we assessed participants' level of trait sports anxiety. For that cause, we applied the German version of the Sports Anxiety Scale-2 (WAI-T; Brand, Ehrlenspiel, & Graf, 2009). Participants reported their level of dispositional sport anxiety on 12 items, with each item answered on 4-point Likert-type scales (1 = *not at all* to 4 = *very much*). The WAI-T consists of three subscales, with each subscale containing four items: worry (e.g., "I worry that I will not play well";  $\alpha = .86$ ), somatic (e.g., "My body feels tense";  $\alpha = .74$ ), and concentration (e.g., "It is hard to concentrate";  $\alpha = .73$ ).

To rule out pre-experimental differences in trait self-control strength, the German short version of the Self-Control Scale was administered (SCS-K-D; Bertrams & Dickhäuser, 2009). Participants answered 13 items (e.g., "I am good at resisting temptations";  $\alpha = .84$ ) on five-point Likert-type scales ranging from 1 (*not at all*) to 5 (*very much*).

After finishing the transcription task, we applied a measure of the degree of self-control exerted while working on the transcription task, consisting of four items (e.g., "How strongly did you have to regulate your writing habits";  $\alpha = .59$ ; Bertrams et al., 2010). Each item was answered on four-point Likert-type scales ranging from 1 (*not at all*) to 4 (*very much*). The purpose of this measure was to make sure that participants from the relaxation condition and the control condition would not differ in the amount of self-control strength invested while working on the transcription task.

Participants' mood was assessed by applying the German version of the Positive and Negative Affect Schedule (PANAS; Krohne, Egloff, Kohlmann, & Tausch, 1996). The PANAS was applied in order to rule out the possibility that the experimental manipulation of relaxation led to differences in participants' mood because we did not aim at improving mood with our

relaxation task, but to replenish self-control strength. Within the PANAS, ten items assess positive mood (e.g., “enthusiastic”;  $\alpha = .82$ ) and ten items assess negative mood (e.g., “afraid”;  $\alpha = .61$ ), with each item being answered on four-point Likert-type scales (1 = *not at all* to 4 = *very much*).

After the two-minute break, participants were asked to indicate their experience with and their attitude toward relaxation techniques on three items (“Have you ever applied relaxation techniques?”; “Would you be open to using relaxation techniques in the future?”; “Do you think relaxation in general is useful?”), which had to be answered on a four-point Likert-type scale (1 = *not at all* to 4 = *very much*). We additionally asked all participants how relaxed they were feeling now compared to their state before the break. Answers were given on a four-point Likert-type scale (1 = *not at all* to 4 = *very much*). It was expected that participants from the relaxation condition compared to the control condition would report a higher level of perceived relaxation.

Following the pressure induction, four positive (joviality, self-assurance, attentiveness, and serenity) and four negative emotional states (sadness, hostility, guilt, and anxiety) derived from the Expanded Form of the Positive and Negative Affect Schedule (PANAS-X; Watson & Clark, 1992) were measured by applying thermometer scales (e.g., Houtman & Bakker, 1989). As state anxiety is a reliable indicator of perceived pressure, the anxiety thermometer was our main interest (e.g., Gucciardi, Longbottom, Jackson, & Dimmock, 2010). The measurements of the other emotional states served as distractors so that it would not be too obvious that the previous pressure instruction aimed at inducing anxiety. On each thermometer, participants placed a cross on a horizontal 10-cm continuous scale, with 0 on the left side of the scale, indicating that the respective emotional state was not experienced at all, and 10 on the right side of the scale, indicating that the respective emotional state was experienced at the highest degree.

The distance from 0 to the cross mark the participant made (in mm) served as the thermometer value for each participant.

## Results

### Preliminary Analyses

The descriptive statistics for the following analyses are depicted in Table 1. An analysis of variance (ANOVA) revealed no significant differences in two of the subscales of the German sports anxiety scale: somatic anxiety  $F(1, 37) = 0.81, p = .37, \eta^2_p = .02$ , concentration  $F(1, 37) = 0.22, p = .64, \eta^2_p = .01$ . However, a significant difference emerged in the worry subscale,  $F(1, 35) = 4.73, p = .04, \eta^2_p = .12$ . Therefore we added the worry subscale as a covariate to our main analyses.

Participants in the relaxation condition did not differ significantly from participants in the control condition in terms of their trait self-control strength,  $F(1, 37) = 0.01, p = .97, \eta^2_p = .00$ , and in the manipulation check for ego depletion,  $F(1, 37) = 2.83, p = .10, \eta^2_p = .07$ . The groups also did not differ significantly in their self-reported positive,  $F(1, 36) = 0.10, p = .76, \eta^2_p = .00$ , or negative mood,  $F(1, 36) = 0.08, p = .78, \eta^2_p = .00$ , following the transcription task.

Participants in the relaxation condition did not differ from participants in the control condition in the number of transcribed words,  $F(1, 37) = 1.20, p = .28, \eta^2_p = .03$ , but they made significantly fewer mistakes compared to participants in the control condition,  $F(1, 37) = 5.03, p = .03, \eta^2_p = .12$ . Therefore, we included this measure as a covariate to our main analyses.

As expected, participants did not differ in their attitudes toward relaxation techniques in general,  $ps > .62$ . Participants from the active relaxation condition reported higher levels of perceived relaxation following the two-minute break compared to participants in the control

condition,  $F(1, 37) = 4.33, p = .05, \eta^2_p = .11$ . This indicated that the experimental manipulation of relaxation was successful.

There were also no significant differences in any of the thermometer scales,  $ps > .26$ . This is in line with our assumption because all participants received the same anxiety instruction. The anxiety scores on the anxiety thermometer were comparable to previous studies which applied the same measurement after an anxiety manipulation indicating that our anxiety induction was successful (e.g., Oudejans & Pijpers, 2010).

- Please insert Table 1 about here -

## Main Analyses

To test the main hypothesis, a 2 x 2 mixed between-/within-participants ANOVA was conducted: experimental condition (relaxation vs control) was the between-participants factor, time of measurement (T1 [prior to the break] vs T2 [after the break]) was the within-participants factor, and the sum score out of 20 basketball free-throws was the dependent variable.

A significant interaction between experimental condition and time of measurement emerged, which indicated that performance in the basketball free-throw task changed from T1 to T2, depending on the experimental condition,  $F(1, 37) = 8.28, p = .01, \eta^2_p = .18$ . Post-hoc pairwise comparisons with Bonferroni corrections revealed that performance in the relaxation condition did not differ between T1 and T2,  $p = .92$ . Participants' performance in the control condition significantly decreased from T1 to T2,  $p < .001$ . This pattern of results remained when adding the worry subscale of the German sports anxiety scale and the number of mistakes committed in the transcription task as covariates into an ANCOVA because there was still a significant interaction between experimental condition and time of measurement,  $F(1, 35) = 5.86, p = .02, \eta^2_p = .14$ . In the relaxation condition, performance remained stable from T1 to T2,

1  $p = .95$ , whereas performance in the control condition got worse from T1 to T2,  $p = .001$  (post-  
2 hoc pair-wise comparisons with Bonferroni corrections).

### 3 **Discussion**

4 Performing at a high level in far-aiming tasks requires selective attention because one  
5 needs to shift attention onto the relevant stimuli at hand while ignoring task-irrelevant stimuli  
6 (e.g., Vickers, 2011). But, according to attentional control theory, individuals are typically less  
7 adept at ignoring task-irrelevant stimuli and find it harder to volitionally regulate their attention  
8 under high levels of evaluative pressure (Eysenck et al., 2007). As attention regulation can be  
9 considered a self-control act (e.g., Schmeichel & Baumeister, 2010), Englert and Bertrams  
10 (2012, 2013) concluded that individuals with available self-control strength can overcome the  
11 automatic attention impairments under evaluative pressure by exerting self-control strength. This  
12 strength may, however, not always be available. According to the strength model of self-control  
13 (Baumeister et al., 1994), the capacity of self-control strength is limited and can be temporarily  
14 depleted, causing an impairment of subsequent self-control acts (e.g., Baumeister et al., 1998).  
15 During depleted self-control strength, pressure-based problems in attention regulation may  
16 therefore not be counteracted, leading to impaired performance. The present work demonstrated  
17 how a strategy to restore depleted self-control strength can be used to avoid decrements in far-  
18 aiming tasks in evaluative pressure situations.

19 Previous research has indicated that rest and active relaxation can lead to a quicker  
20 replenishment of self-control strength, enabling individuals to perform up to their capabilities  
21 (Tyler & Burns, 2008). In the present studies, initial support was found for the hypothesis that  
22 active relaxation can protect against the repeatedly documented negative effects of ego depletion  
23 on performance under evaluative pressure (Englert & Bertrams, 2012, 2013).

We would also like to address two central limitations of our studies: We only tested participants with depleted self-control strength and did not include control groups that did not become ego depleted. In the same vein, anxiety was not experimentally manipulated. A comparison with other studies in which similar experimental setups were applied revealed comparable anxiety scores (e.g., Oudejans & Pijpers, 2010) and similar scores on the ego depletion manipulation check (e.g., Englert & Bertrams, 2012), indicating that we successfully induced anxiety and ego-depletion. The reason why we only addressed situations in which people are ego depleted and additionally under pressure was that related previous research reliably found performance decrements only under such conditions; no performance impairment emerged when individuals were not depleted or felt no pressure (e.g., Bertrams et al., 2013; Englert & Bertrams, 2012, 2013).

Second, we postulated that ego depletion would negatively affect attention regulation, which can be overcome by active relaxation. However, we did not assess attention regulation directly. This limitation can be overcome in future research by applying sophisticated methods, such as eye-tracking technology. The gaze behavior of an individual can be viewed as an indicator of efficient attention regulation (Henderson, 2003). Shorter fixation durations on the relevant target areas are a sign of less efficient selective attention regulation (e.g., Wilson et al., 2009). To conclude, the present studies should be replicated by additionally assessing participants' attentional focus (e.g., with respect to specific areas on the basket) to further foster our argument that active relaxation leads to a quicker replenishment of self-control strength and can improve performance in far-aiming tasks requiring selective attention regulation.

As previously mentioned, apart from active relaxation (Tyler & Burns, 2008), there are also other possibilities to improve self-control strength and to counteract ego-depletion effects

(for an overview, see Baumeister et al., 2006), for instance, regular self-control exertion (e.g., Oaten & Cheng, 2006; Gailliot et al., 2007) or mindfulness meditation (Frieze et al., 2012). Thus far, these other training techniques have not been transferred to the field of sports. Future research should therefore also apply such training regimens to these domains in the hopes of improving (athletic) performance under pressure.

The present finding could have important implications for the way breaks are being used during sporting competitions. Apparently simply resting does not have the same favorable effects as active relaxation. These results are in line with other research in the field of sport psychology that has also stressed the beneficial effects of relaxation for peak performance (e.g., Williams, 2006). Some sports do include breaks (e.g., halftime break during a soccer match) while other sports do not offer the opportunity to just rest for a short period of time (e.g., running). Therefore, future studies should aim to identify ways to revitalize depleted self-control strength even in sports where there are no official breaks. To conclude, we feel that active relaxation can be a quick and efficient way to enable athletes to display their optimal level of performance under evaluative pressure, even if any demands recently stressed their self-control strength. Thus, we would recommend implementing active relaxation before and during sporting competitions.

### References

- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology*, 74, 1252–1265.
- Baumeister, R. F., Gailliot, M., DeWall, C. N., & Oaten, M. (2006). Self-regulation and personality: How interventions increase regulatory success, and how depletion moderates the effects of traits on behavior. *Journal of Personality*, 74, 1773–1801.
- Baumeister, R. F., Heatherton, T. F., & Tice, D. M. (1994). *Losing control: How and why people fail at self-regulation*. San Diego, CA: Academic Press.
- Behan, M., & Wilson, M. (2008). State anxiety and visual attention: The role of the quiet eye period in aiming to a far target. *Journal of Sports Sciences*, 26, 207–215.
- Bertrams, A., & Dickhäuser, O. (2009). Messung dispositioneller Selbstkontroll-Kapazität: Eine deutsche Adaptation der Kurzform der Self-Control Scale (SCS-K-D). *Diagnostica*, 55, 2–10.
- Bertrams, A., Englert, C., & Dickhäuser, O. (2010). Self-control strength in the relation between trait test anxiety and state anxiety. *Journal of Research in Personality*, 44, 738–741.
- Bertrams, A., Englert, C., Dickhäuser, O., & Baumeister, R. F. (2013). Role of self-control strength in the relation between anxiety and cognitive performance. *Emotion*, 13, 668–680.
- Boutcher, S. H. (2002). Attentional processes and sport performance. In T. S. Horn (Ed.), *Advances in sport psychology* Champaign, IL: Human Kinetics. Pp. 441–457.
- Brand, R., Ehrlenspiel, F., & Graf, K. (2009). *Wettkampf-Angst-Inventar (WAI). Manual zur komprehensiven Eingangsdiagnostik von Wettkampfangst, Wettkampfstress und*



- Angstbewältigungsmodus im Sport* [Competition Anxiety Inventory. Manual for comprehensive diagnostics of competitive trait and state anxiety, and coping]. Köln: Sportverlag Strauß.
- Corbetta, M., & Shulman, G.L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nature Reviews Neuroscience*, 3, 201–215.
- Englert, C., & Bertrams, A. (2012). Anxiety, ego depletion, and sports performance. *Journal of Sport and Exercise Psychology*, 34, 580–599.
- Englert, C., & Bertrams, A. (2013). Too exhausted for Operation? Anxiety, depleted self-control strength, and perceptual-motor performance. *Self and Identity*, 12, 650–662.
- Englert, C., & Bertrams, A. (2015). Integrating attentional control theory and the strength model of self-control. *Frontiers in Psychology*, 6, 824.
- Englert, C., & Wolff, W. (2015). Ego depletion and persistent performance in a cycling task. *International Journal of Sport Psychology*, 46, 137-151
- Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, 7, 336–353.
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G\* Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175–191.
- Friese, M., Hofmann, W., & Wänke, M. (2008). When impulses take over: Moderated predictive validity of implicit and explicit attitude measures in predicting food choice and consumption behavior. *The British Journal of Social Psychology*, 47, 397–419.
- Friese, M., Messner, C., & Schaffner, Y. (2012). Mindfulness meditation counteracts self-control depletion. *Consciousness and Cognition*, 21, 1016–1022.

- Furley, P., Bertrams, A., Englert, C., & Delphia, A. (2013). Ego depletion, attentional control, and decision making in sport. *Psychology of Sport and Exercise, 14*, 900–904.
- Gailliot, M. T., Plant, E. A., Butz, D. A., & Baumeister, R. F. (2007). Increasing self-regulatory strength can reduce the depleting effect of suppressing stereotypes. *Personality and Social Psychology Bulletin, 33*, 281–294.
- Gucciardi, D. F., Longbottom, J. L., Jackson, B., & Dimmock, J. A. (2010). Experienced golfers' perspectives on choking under pressure. *Journal of Sport and Exercise Psychology, 32*, 61–83.
- Hagger, M. S., Wood, C., Stiff, C., & Chatzisarantis, N. L. D. (2010). Ego depletion and the strength model of self-control: A meta-analysis. *Psychological Bulletin, 136*, 495–525.
- Henderson, J. M. (2003) Human gaze control during real-world scene perception. *Trends in Cognitive Sciences, 7*, 498–504.
- Houtman, I. L. D., & Bakker, F. C. (1989). The anxiety thermometer: A validation study. *Journal of Personality Assessment, 53*, 575–582.
- Krohne, H. W., Egloff, B., Kohlmann, C-W., & Tausch, A. (1996). Untersuchungen mit einer deutschen Version der “Positive and Negative Affect Schedule” (PANAS) [Investigations with a German version of the Positive and Negative Affect Schedule (PANAS)]. *Diagnostica, 42*, 139–156.
- Nibbeling, N., Oudejans, R. R. D., & Daanen, H. A. M. (2012). Effects of anxiety, a cognitive secondary task, and expertise on gaze behavior and performance in a far aiming task. *Psychology of Sport and Exercise, 13*, 427–435.
- Oaten, M., & Cheng, K. (2006). Longitudinal gains in self-regulation from regular physical exercise. *British Journal of Health Psychology, 11*, 717–733.

- Oudejans, R. R. D., & Pijpers, J. R. (2010). Training with mild anxiety may prevent choking under higher levels of anxiety. *Psychology of Sport and Exercise, 11*, 44–50.
- Oudejans, R. R. D., van de Langenberg, R. W., & Hutter, R. I. (2002). Aiming at a far target under different viewing conditions: Visual control in basketball jump shooting. *Human Movement Science, 21*, 457–480.
- Schmeichel, B. J., & Baumeister, R. F. (2010). Effortful attention control. In B. Bruya (Ed.), *Effortless attention: A new perspective in the cognitive science of attention and action*. Cambridge, MA: MIT Press. Pp. 29–49.
- Thibaudet, J. Y. (2002). Gymnopedie No. 1. *On The Magic of Satie [CD]*. New York: Decca Music.
- Tyler, J. M., & Burns, K. C. (2008). After depletion: the replenishment of the self's regulatory resources. *Self and Identity, 7*, 305–321.
- Vickers, J. N. (2011). Mind over muscle: The role of gaze control, spatial cognition, and the quiet eye in motor expertise. *Cognitive Processing, 12*, 219–222.
- Watson, D. A., & Clark, L. A. (1992). Affects separable and inseparable: On the hierarchical arrangement of the negative affects. *Journal of Personality and Social Psychology, 62*, 489–505.
- Williams, J. M. (2006). *Applied sport psychology: Personal growth to peak performance*. New York: McGraw-Hill.
- Wilson, M. R., Vine, S. J., & Wood, G. (2009). The influence of anxiety on visual attentional control in basketball free throw shooting. *Journal of Sport and Exercise Psychology, 31*, 152–168.

Wolff, W., Baumgarten, F., & Brand, R. (2013). Reduced self-control leads to disregard of an unfamiliar behavioral option: an experimental approach to the study of neuroenhancement. *Substance Abuse Treatment, Prevention, and Policy*, 8, 41–48.

Table 1

*Descriptive Statistics: Means and Standard Deviations (N = 39)*

Variable	Experimental condition			
	Relaxation		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Free-Throws (total score)				
T1 (baseline)	14.65	2.83	13.63	3.11
T2 (after break)	14.70	3.34	11.74	2.94
SCS-K-D	3.23	0.59	3.22	0.71
WAI-T				
Somatic	2.05	0.57	2.22	0.64
Worry	2.08	0.67	2.51	0.54
Concentration	1.64	0.68	1.72	0.44
Transcription task				
Self-control exerted	2.99	0.44	3.21	0.38
Number of transcribed words	86.80	11.05	91.63	16.13
Number of mistakes	3.90	2.63	6.58	4.61
PANAS				
Positive affect	2.93	0.66	2.87	0.59
Negative affect	1.27	0.29	1.25	0.29
Manipulation check				
Relaxation experienced	3.15	0.88	2.58	0.84
Thermometer Scales				
Joviality	5.90	1.99	5.50	2.24
Self-assurance	6.48	1.34	5.93	2.18
Attentiveness	6.16	1.44	6.65	1.26
Serenity	5.97	1.76	5.28	2.16
Sadness	0.74	1.19	1.20	1.53
Hostility	0.92	1.21	1.25	2.03
Guilt	0.59	0.66	0.65	0.92
Anxiety	3.83	2.37	4.05	2.48

*Note.*  $n = 20$  in relaxation condition,  $n = 19$  in control condition. Overall scores of a

psychometric scale were obtained by averaging the responses to the scale items. Free-throws T1

= Total number of successful basketball free-throws out of 20 throws at T1. Free-throws T2 =

Total number successful of basketball free-throws out of 20 throws at T2. WAI-T =

- 1 Wettkampfstressinventar (German version of the Sports Anxiety Scale, SAS-2). SCS-K-
- 2 D = German short version of the Self-Control Scale. PANAS positive = German version of the
- 3 Positive and Negative Affect Schedule – positive affect. PANAS negative = German version of
- 4 the Positive and Negative Affect Schedule – negative affect.